

This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found [here](#).

If you have a suggestion to make the keys better, please fill out the short survey [here](#).

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

1. Simplify the expression below and choose the interval the simplification is contained within.

$$4 - 20^2 + 2 \div 6 * 16 \div 7$$

The solution is -395.238 , which is option A.

- A. $[-395.45, -394.63]$

* -395.238 , this is the correct option

- B. $[403.57, 404.34]$

404.003 , which corresponds to two Order of Operations errors.

- C. $[-396.71, -395.71]$

-395.997 , which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

- D. $[404.69, 404.85]$

404.762 , which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

- E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

2. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{576}{49}}$$

The solution is Rational, which is option A.

- A. Rational

* This is the correct option!

- B. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

- C. Irrational

These cannot be written as a fraction of Integers.

- D. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

E. Integer

These are the negative and positive counting numbers (... , -3, -2, -1, 0, 1, 2, 3, ...)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\frac{24}{7}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

3. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{54 + 44i}{-1 + 5i}$$

The solution is $6.38 - 12.08i$, which is option D.

A. $a \in [-55.5, -53]$ and $b \in [8.74, 8.84]$

$-54.00 + 8.80i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [6, 7.5]$ and $b \in [-314.01, -313.96]$

$6.38 - 314.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [165, 167]$ and $b \in [-12.08, -12.05]$

$166.00 - 12.08i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [6, 7.5]$ and $b \in [-12.08, -12.05]$

* $6.38 - 12.08i$, which is the correct option.

E. $a \in [-11, -10]$ and $b \in [8.65, 8.71]$

$-10.54 + 8.69i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

4. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-10 + 2i)(-4 + 3i)$$

The solution is $34 - 38i$, which is option A.

A. $a \in [34, 36]$ and $b \in [-44, -34]$

* $34 - 38i$, which is the correct option.

B. $a \in [42, 50]$ and $b \in [-25, -21]$

$46 - 22i$, which corresponds to adding a minus sign in the first term.

C. $a \in [34, 36]$ and $b \in [34, 39]$

$34 + 38i$, which corresponds to adding a minus sign in both terms.

D. $a \in [38, 42]$ and $b \in [-9, 10]$

$40 + 6i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

E. $a \in [42, 50]$ and $b \in [17, 27]$

$46 + 22i$, which corresponds to adding a minus sign in the second term.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

5. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{-1815}{11}} + \sqrt{0}i$$

The solution is Pure Imaginary, which is option B.

A. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

B. Pure Imaginary

* This is the correct option!

C. Nonreal Complex

This is a Complex number ($a + bi$) that is not Real (has i as part of the number).

D. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

E. Rational

These are numbers that can be written as fraction of Integers (e.g., $-2/3 + 5$)

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

6. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-2 + 8i)(5 + 7i)$$

The solution is $-66 + 26i$, which is option C.

A. $a \in [-68, -63]$ and $b \in [-26.15, -24.4]$

$-66 - 26i$, which corresponds to adding a minus sign in both terms.

B. $a \in [46, 49]$ and $b \in [53.91, 54.51]$

$46 + 54i$, which corresponds to adding a minus sign in the second term.

C. $a \in [-68, -63]$ and $b \in [25.99, 27.39]$

* $-66 + 26i$, which is the correct option.

D. $a \in [-18, -5]$ and $b \in [55.28, 56.57]$

$-10 + 56i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

E. $a \in [46, 49]$ and $b \in [-54.41, -53.76]$

$46 - 54i$, which corresponds to adding a minus sign in the first term.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

7. Simplify the expression below and choose the interval the simplification is contained within.

$$18 - 12^2 + 7 \div 8 * 13 \div 16$$

The solution is -125.289 , which is option A.

A. $[-125.62, -124.54]$

* -125.289 , this is the correct option

B. $[-126.26, -125.96]$

-125.996 , which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[161.86, 162.42]$

162.004 , which corresponds to two Order of Operations errors.

D. $[162.05, 162.91]$

162.711 , which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

8. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{2}{-11} + 81i^2$$

The solution is Rational, which is option C.

A. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

B. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

C. Rational

* This is the correct option!

D. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

E. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

9. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{63 + 22i}{-5 - i}$$

The solution is $-12.96 - 1.81i$, which is option A.

A. $a \in [-13.39, -12.83]$ and $b \in [-3, -1]$

* $-12.96 - 1.81i$, which is the correct option.

B. $a \in [-13.39, -12.83]$ and $b \in [-48, -45]$

$-12.96 - 47.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-12.9, -12.46]$ and $b \in [-23.5, -21.5]$

$-12.60 - 22.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [-337.01, -336.76]$ and $b \in [-3, -1]$

$-337.00 - 1.81i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [-11.33, -11.17]$ and $b \in [-8.5, -6]$

$-11.27 - 6.65i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

10. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{-990}{5}}$$

The solution is Not a Real number, which is option E.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Integer

These are the negative and positive counting numbers (... , -3, -2, -1, 0, 1, 2, 3, ...)

C. Irrational

These cannot be written as a fraction of Integers.

D. Rational

These are numbers that can be written as fraction of Integers (e.g., $-2/3$)

E. Not a Real number

* This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\sqrt{198}i$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.
